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1. Your reference — T&B/62186/000

2. Patent application number *(The Patent Office will fill in this part)* — 10 JAN 2003 — 0300599.8

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

De La Rue International Limited
De La Rue House
Jays Close
Viables
Basingstoke
Hampshire, RG22 4BS

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation — **United Kingdom**

7563620 01

4. Title of the invention — **Magnetic Threads**

5. Name of your agent *(if you have one)* — **BOULT WADE TENNANT**

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

VERULAM GARDENS
70 GRAY'S INN ROAD
LONDON WC1X 8BT

Patents ADP number *(if you know it)* — **42001**

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Country	Priority application number (if you know it)	Date of filing *(day/month/year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

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Claim(s)	0
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Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	0
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11 I/We request the grant of a patent on the basis of this application.

Signature Date

10 January 2003

12. Name and daytime telephone number of person to contact in the United Kingdom

Tessa A Bucks
020 7430 7500

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Improved Security Thread

The current invention relates to a security element for security substrates such as those used for banknotes and the like, having enhanced public recognition, anti-counterfeit and detection properties.

It is widely known to include security elements such as security threads or strips into security documents to protect against forgery. Typically these threads comprise a polymer carrier onto which a metal layer is applied, though they may also have additional functional layers such as magnetics, thermochromics or luminescence.

Threads of this type have the advantage that they can be verified both visually and by machine. There is a constant need to improve the security of these devices in order to remain one step ahead of the counterfeiter. Developments have included improving the public recognition, machine readable, and anti-counterfeit properties.

Public recognition or visually identifiable features have been known for some time and include threads with microprint; metallic indicia on a transparent thread (EP 279880, US 4941617 & US 44652015) and metallic thread with transparent indicia (EP 0319157). The latter is known as Cleartext® commercially and is utilised in a number of the worlds major currencies. Cleartext has proved to be highly successful due the ease of which the public can verify it without the need for additional aids or equipment. A variant of the Cleartext thread is described in EP659587, here the thread is provided with demetallised characters of varying heights. The principles behind Cleartext have been further improved by enhancing both the anti-counterfeit and

aesthetic properties as described in EP972111. Here the security element design comprises at least one repeating geometric pattern of which one of more of the frequency, instantaneous amplitude and/or maximum amplitude of the pattern varies along the length of the element and design having at least one non-linear boundary. Such designs are much harder to counterfeit and consequently more secure. They also have the additional benefit of being highly aesthetic and can be designed in such a way as to co-ordinate with other design features on a document.

It has also been recognised that there is an increasing need to be able to identify and characterise security documents automatically by machine. This can be achieved by the provision of additional functional layers to security elements as described earlier. It is particularly common to make use of magnetic layers and more recently coded magnetic layers. One such coded security element is described in EP 0407550. Here the code is provided in the form of a machine-readable binary code in the magnetic layer. The code consists of alternating 'termination' and 'word' segments, which are made up of blocks or 'bits' of magnetic coating. Each word segment has the same length, with the presence of magnetic material in a bit denoting a '1', and the absence of magnetic material a '0'. This thread allows for unique identification of the thread but is not intended as a publicly verifiable feature.

The need to combine the benefits of a machine readable layer and the public recognition properties of Cleartext has been recognised and EP 0516790 describes a security element comprising a transparent carrier material, a metallic layer with gaps and a magnetic layer disposed above or below the metal layer. The gaps take the form of characters, patterns or other indicia

and are located in those areas where no magnetic layer is present, thus ensuring that the negative writing on the thread is readable in transmitted light. The thread may additionally have an additional magnetic layer, electro-conductive material added to the magnetic layer or magnetic material added to the metallic layer, providing a form of 'coding'. This thread has the advantage that it combines an easily recognisable feature with a machine-verifiable one.

EP 0961996 and EP 0938417 disclose further improved security elements comprising a plastic layer, an opaque layer with gaps and a magnetic layer. Similar to EP 0516790 the gaps are positioned in those areas where no magnetic layer is present so they are visible in transmitted light, but the magnetic layer is additionally periodically spaced with non-magnetic areas to form a coding. The coding may take the form of the codes described in EP 0407550, or may be of a different type.

Though both EP 0516790 and EP 0961996 do provide both public and machine-readable properties the current invention seeks to further improve on the machine readable, public recognition and anti-counterfeit properties.

Key to the current invention is the recognition that the primary level of authentication in the majority of cases is by public inspection. Though the inventors recognise that machine inspection is typically of paramount importance when authenticating a document this may only occur a limited number of times during the life of a document. For certain denominations this may only be twice, just prior to issuance by a central bank and upon return to a central bank. A far more regular occurrence is the need for the public to rapidly authenticate a document either with or without any additional aids.

The inventors have recognised that in both EP 0516790 and EP 0961996 the visual aspects of the security element have been compromised in order to accommodate the magnetic and machine-readable aspects. Examples in both patents show the demetallised, public recognition, region constrained in order to allow for the magnetic features.

Within the current invention it is the visual features that take precedence and the magnetic features, which are secondary. It is also the intention of the current invention to allow for the incorporation of more complex design elements such as those described within EP972111 thus enhancing the anti-counterfeit properties of the security element. As indicated previously structures of the type described in EP972111 can also be used in such a way as to enhance the public recognition properties by carrying design themes through from the document into the thread design. This is particularly the case where wider security elements are used. The design theme may mirror a guilloche, medallion or white line pattern printed on the document or be a representation of a watermark image within the paper alternatively some other design feature may be used.

It has also been found that threads produced according to the current invention can be read using the installed base of magnetic thread detectors. Thus retaining the current need to read threads by machine. In addition the distribution of magnetic ink printed on the security elements can be utilised as a unique identifier, though this may require some enhancements to the thread detection equipment.

According to the invention there is therefore provided a security element for wholly or partially embedding in security paper, comprising an elongate strip

of a light transmitting polymeric substrate, such substrate bearing a layer of magnetic ink and a reflective metallic layer on at least one surface thereof with gaps in the form of a design, said design comprising at least one repeating pattern of which one or more of the frequency, the instantaneous amplitude and/or the maximum amplitude of the pattern varies along the length of the element, with the gaps positioned relative to the magnetic layer such that they do not overlap. The magnetic layer may be continuous or discontinuous and applied as indicia, characters, patterns, designs, geometrical shapes or the like.

The invention will now be described by reference to the following figures.

Figures 1,2 and 3 illustrate designs used in the prior art.

Figures 4-15 show examples of the present invention.

Figures 16-24 show examples of the current invention enlarged.

The present invention provides enhanced security by combining complex designs that are difficult to forge with machine-verifiable features. It does so by designing the magnetic layer around the visual design rather than accommodating the design to the magnetic layer as in EP 0961996 & EP 0516790. The current invention is equally applicable for security elements having either positive or negative demetallisation as illustrated in the figures. As indicated earlier the need for secure publicly recognisable security features is of paramount importance for Banknotes and other documents of value. Cleartext threads are now present in many of the worlds major Currency's and consequently the public is very familiar with the feature. The current invention makes use of the familiar, public recognition, aspects of Cleartext but further enhances the security against counterfeiting.

The prior art to date has focused on providing a machine-readable variant of Cleartext in both uncoded and coded forms. Whereas these provide improved machine readability for use by central banks they do not enhance the security of the device for the general public. The current invention recognises that provision of a machine-readable security element is important but of greater importance is the need to provide a high degree of public security. The improved public security could not be provided by the security elements described in the prior art as the visually features are constrained by the distribution of the magnetic material. To appreciate the value of the current invention it is important to understand how a counterfeit banknote gets passed.

When producing a counterfeit note the primary concern for the majority of counterfeiters is passing the note in a shop or retailer. Generally a counterfeiter is not concerned with providing a counterfeit that can be machine verified by a commercial or central bank. To this end there is little need for a counterfeiter to reproduce the machine readable features such as the magnetics on the security elements/threads. To replicate the magnetic features would be difficult, expensive, and provide no additional benefit to the counterfeiter when trying to pass a note in a shop. Retailers when accepting notes generally rely on how a note looks and how a note feels. One key aspect of how a note looks are the embedded security features such as threads and watermarks. In order to pass a counterfeit note a counterfeiter will go to great lengths to replicate threads and watermarks using a number of techniques such as printing and foil blocking. It is therefore of great importance that features such as threads are made as hard as possible to

replicate by counterfeiters and thus remain valued as public recognition features. The current invention has been developed with a view to retaining the machine-readable features of use to central banks but also further improving the public security aspects of demetallised Cleartext threads. However as a further additional benefit it has been found that the security of the machine readable aspect of the security element is also improved as a consequence of the improved public security. A disadvantage of both EP516790 and EP961996 is they both result in clearly distinct areas of plain metal with no demetallisation present. Implementations of both patents result in either tramlines along either edge or blocks of metal along the length of the security element. In either implementation these areas are clearly distinct from the demetallised design regions draw attention to the fact that something else may be present. This in turn encourages would be counterfeiters to investigate and identify the presence of the magnetic material. The counterfeiter may then take steps to replicate the magnetic feature as well as the demetallised design. This would be not be a trivial step for the counterfeiter but if achieved could seriously undermine the security of the document. It is preferable that attention is not drawn to such features so no attempt is made to replicate them. In the current invention the demetallised design takes precedence over the magnetic features, so less attention is drawn to the regions where no demetallisation is present. Consequently the attention of a would be counterfeiter is not drawn to the wholly metallised regions and the need to investigate whether they are masking additional features. As indicated above it is unlikely the majority of counterfeiters would wish to try and replicate the magnetic feature but by drawing their attention to

it you increase the risk of an attempt being made. The current invention reduces the risk of this occurrence by not drawing the counterfeiters attention to the magnetic feature.

As a further surprising benefit of the present invention it has been found that using different size and shape magnetic areas to accommodate the demetallised regions creates a unique identifier for a security element. Thus the security element may have a binary code dictated by 'word' and 'termination' segments as disclosed in EP 0407550, and a secondary more complex code dictated by the intensity and distribution of the segments. It has also been found that the thickness of the magnetic layer applied influences the magnetic reading, so that a thicker layer results in a machine-readable increase in magnetic intensity. Thus applying a thicker layer of magnetic ink to predetermined word and termination segments may enhance the secondary code.

A further advantage in the current invention lies in the potential for the security element to also be authenticated at a teller assist level. A teller is provided with a magnetic viewer, such as those sold by Sigma Hi-Chemical Inc under the trade name MV-95. This can be placed on the thread to reveal the presence of a magnetic feature. In this instance the magnetic feature can be provided in such a way as to complement the visible feature and as such when viewed through the magnetic viewer is instantly recognisable. Thus enabling the teller to rapidly verify that the security element and therefore document is genuine.

Figures 1, 2 and 3 illustrate designs used in the prior art. In both cases it can clearly be seen that the visual design features have been constrained in order

to accommodate the need for a magnetic feature. Please note in all figures the design regions and magnetic regions are shown but it should be appreciated that the magnetic regions will not be visible as an opaque metal layer masks them. Such constructions have been utilised and are currently present in some currencies. The construction does provide limitations on the range of demetallised designs that can be used and does compromise the aesthetic quality of the security element even when embedded into paper. The inventive security element is manufactured according to methods known to those skilled in the art. For example the security element may be manufactured in accordance with the teaching of EP 0961996 & EP 0516790. That is a security element comprises a transparent plastic film on to which a magnetic layer is applied on at least one side thereof. A metallic layer is then applied to the magnetic layer by a suitable method such as vacuum deposition, and the layer is provided with gaps using a heat-softening or vaporable inks for example by the method described in EP 0330733 & EP 0516790 or by any of the known methods such as resist and etch. The film is slit to form individual security elements or threads, having a width of between 0.8mm – 30mm. The security element is then inserted into paper i.e. on a cylinder mould machine so that it is either wholly or partially embedded within the paper fibres. The method by which the security element is embedded can either be by the method described in EP 0070172, EP 0059056, EP860298 or EP 0229654.

Figure 4 illustrates a security element manufactured according to the current invention. The security element is provided with indicia along its length. Unlike the prior art examples the position of the indicia varies constantly and

repeatedly along the length of the security element. This variation in position increases the visual impact of the text. The magnetic region may be provided as bit segments as described in EP 0407550, this is illustrated in figure 5. In figure 4 the magnetic material is printed along both edges of the security element such that the height of the magnetic material varies. The height variation along either edge being such that the amount of magnetic material present in any cross section of the thread is constant.

As an alternative the magnetic material may be provided in a discontinuous manner along the top and bottom edges as shown in figures 6. Again even though the magnetic material is discontinuous along each edge the amount of magnetic material present in a cross section of the thread remains constant. A similar principle applies when the magnetic material is printed in a coded format as shown in figures 5 and 7. Here the amount of magnetic material relating to a particular bit will remain the same be it printed along one edge or partially printed along both edges.

Figures 8 and 9 illustrates another security element conforming to the current invention. Here the height of the text is varied in a constant and repeating manner with the magnetic regions occupying the non-design areas.

In the examples described thus far we have focused on the combination of the magnetic layer with demetallised indicia of varying position and/or height. However the current inventions also lends itself particularly well to other forms of demetallised design. Figures 10-24 show some alternative designs for the non-metal and magnetic regions. Here the non-metal designs are based on the type of designs disclosed in EP972111. Within EP972111 we teach to provide demetallised threads with either very fine metal or non-metal regions

with non-linear boundaries. Such designs are very much harder to replicate by counterfeiters using the techniques commonly used to mimic security threads e.g. foil blocking. Here the security of the security elements is further enhanced with the provision of magnetic materials. As can be seen in all examples the magnetic material has been provided in a manner, which does not compromise the design of the non-metal regions and thus their security. In figures 14 and 15 the magnetic material also been printed in manner that complements the design of the non-metal regions. This is a unique approach and intended to act as a teller assist feature. As the magnetic material is hidden in an opaque metal layer it cannot be seen so previously no effort has been made to provide the magnetic material with any design features. The current inventors recognise that with the use of magnetic viewers, such as those sold by Sigma Hi-Chemical Inc under the trade name MV-95, teller can instantly recognise the magnetic materials presence and due to the complimentary design features is further reassured that the device is genuine. The thread could potentially also be detected using automatic detection equipment.

Figures 16-24 show enlarged regions of the various thread designs. The figures clearly show how the magnetic material has been printed in order to accommodate the demetallised design.

Magnetic or metallic inks with different characteristics may also be used in the current invention. At least one magnetic and/or metallic ink of differing predetermined characteristics to the first or an admixture of electro-conductive material to the magnetic layer, may be applied to the security element as disclosed in EP 0516790 & EP 0961996. The relative location, intensity and

properties of the metallic and/or magnetic inks provide a number of coding possibilities and enhance security, but the second layer must not impair the readability of the coding of the first layer.

The second layer may be applied in the form of a coding identical to the first layer, parallel or relative to it. The double coding makes it possible to perform a coincidence test wherein the coding is read independently of each other and tested for agreement. As an alternative approach the two codes may be different and readable using a different technique or process. The second layer may be magnetic, either hard or soft, but could also be a different machine readable functional layer such as IR absorbing, or luminescent.

If the second layer acts as a magnetic 'continuity' check a much smaller thickness than that required for the coding layer can be used. This means that when a sensor being used to detect coding will not receive any signal from the second magnetic layer. Since the sensors for reading magnetic coding usually require a strong signal, the magnetic material for coding must have a certain minimum thickness. However, for a continuity check along the length of the thread a much thinner layer is sufficient. In the example above two layers of differing thickness could therefore be applied - a thicker layer for coding and a thinner layer for a continuity check. The continuity layer must be sufficiently thinner than the coding layer so that a sensor being used to detect the coding receives no interference signal. Alternatively different magnetic inks e.g. soft and hard magnetic inks could be used to distinguish between the two layers.

The inventors recognise that the current invention may also be combined with other function and feature layers as is well known in the prior art. Other

functional layers could include but are not limited to luminescence and IR absorbing materials. Other feature layers include, but are not limited to, photochromics, thermochromics, and optically variable layers. Examples of optically variable layers include diffractive, holographic, iridescent, pearlescent, OVI®, liquid crystal or different coloured metal layers. Though it should be appreciated that any material showing a perceptible change in appearance with change in viewing angle could be used. Where liquid crystal and iridescent or pearlescent layers are used it is preferable to use a dark background to enhance their appearance. Examples of how liquid crystal layers can be incorporated into thread constructions can be found in the applicant's co-pending application GB0201767.

The security element will typically be embedded either wholly or partially into a paper or polymer substrate, alternatively it may be applied in such a manner as to remain fully exposed on a surface. Where the security element is to be applied to the surface of a document instead of being embedded during manufacture the security element can be prepared as a separate foil transfer device and transferred to the document.

The security substrate may be printed on one or both sides to identify the article or document. This printing may include one or more of the repeating patterns of the design on the security element itself or indeed the whole design.

The security element may be used on or in bank notes, and any other security documents such as cheques, ID cards, bonds, certificates of authenticity, postal stamps, fiscal stamps, brand protection articles, security labels, vouchers and the like.

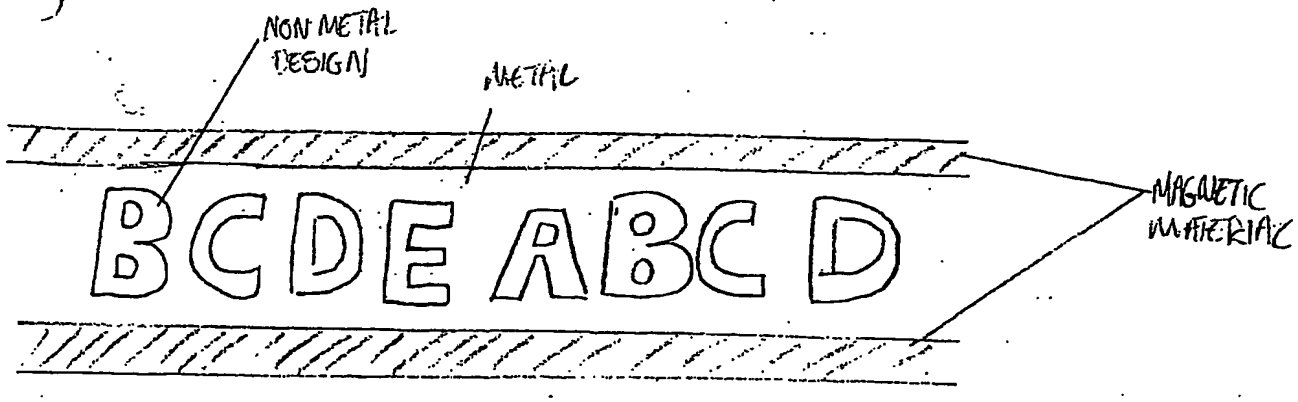

FIGURE 1

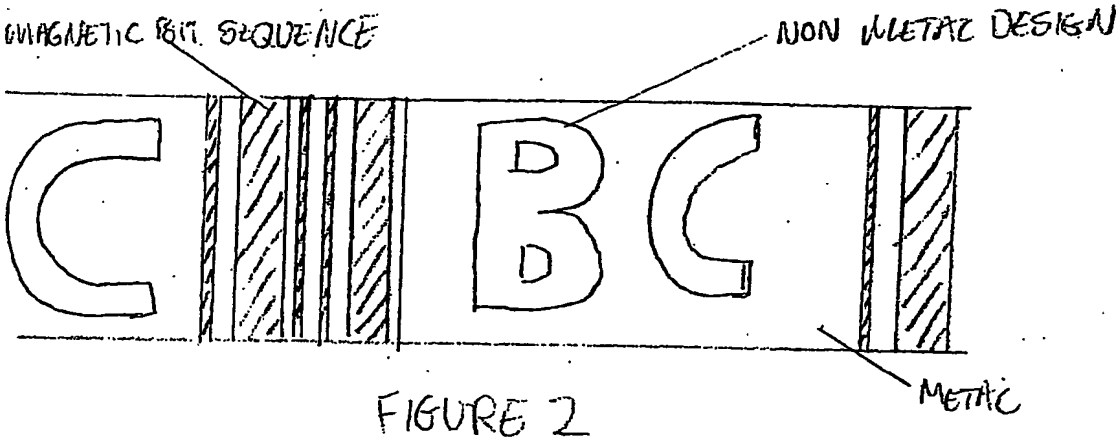

FIGURE 2

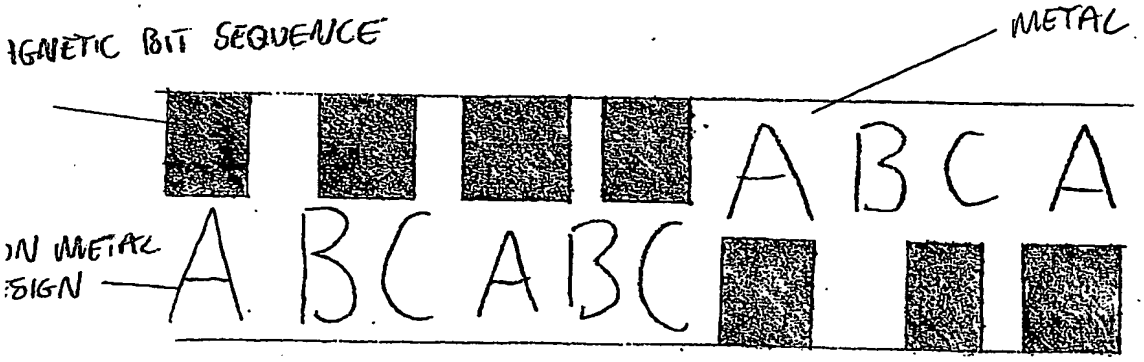

FIGURE 3

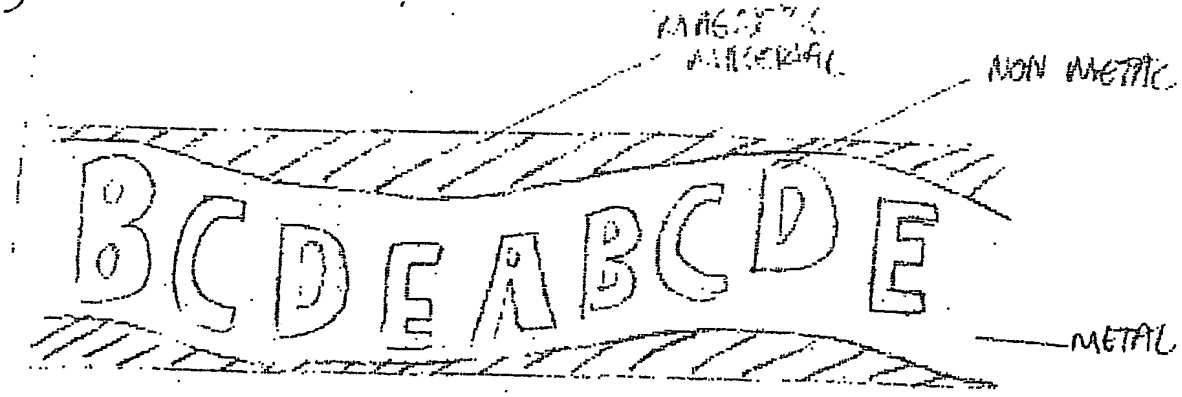

FIGURE 4

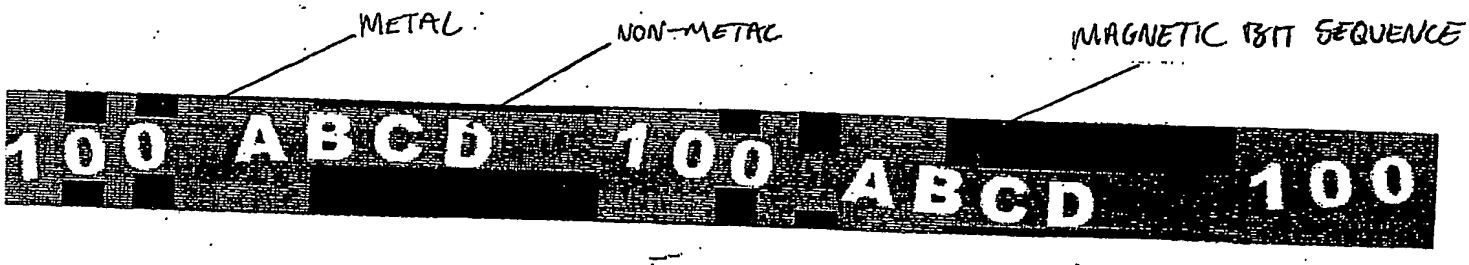

FIGURE 5

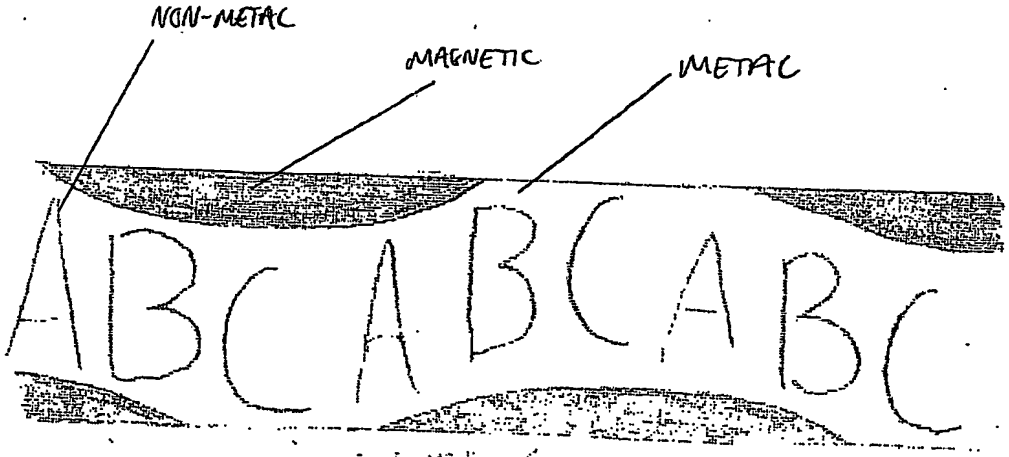

FIGURE 6

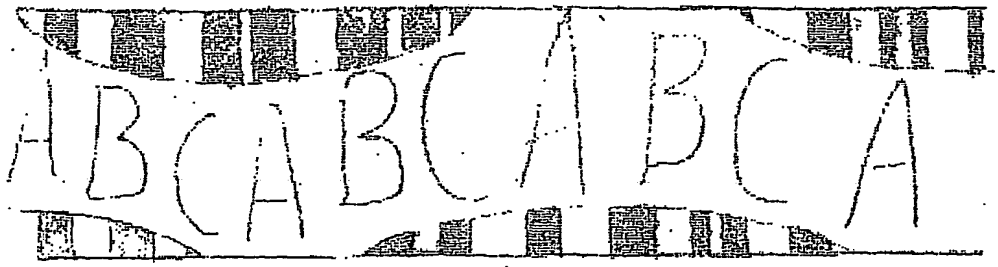

FIGURE 7

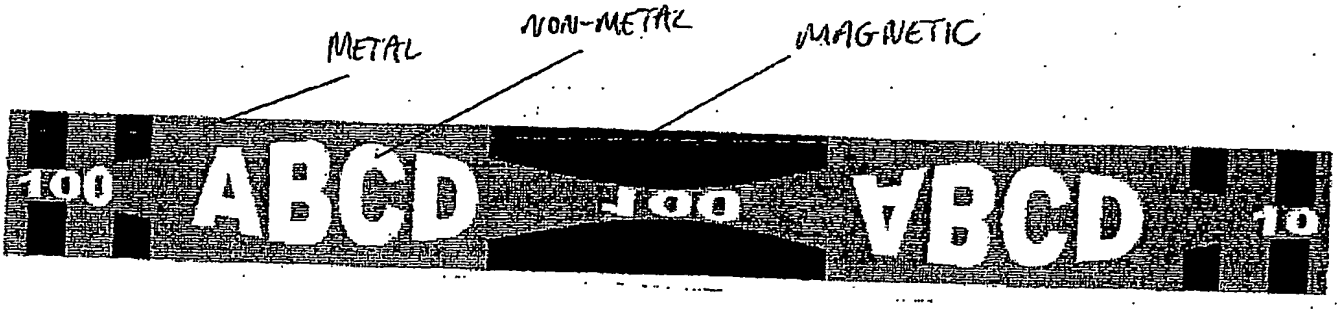

FIGURE 8

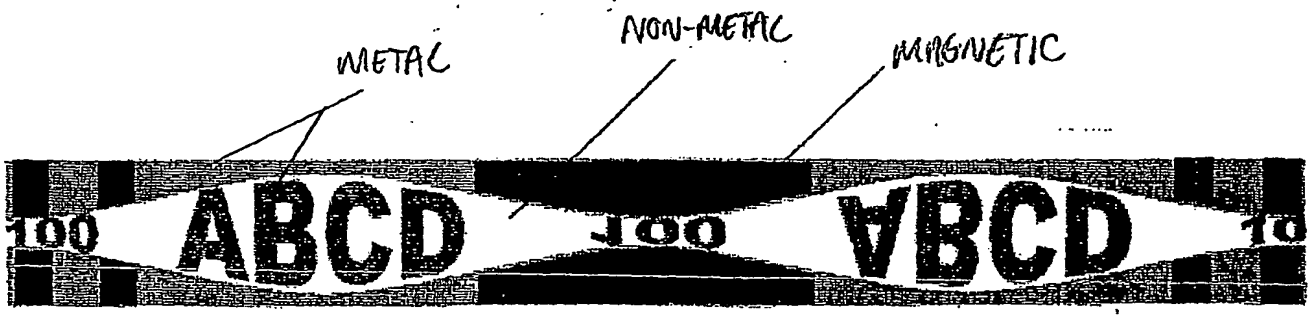

FIGURE9

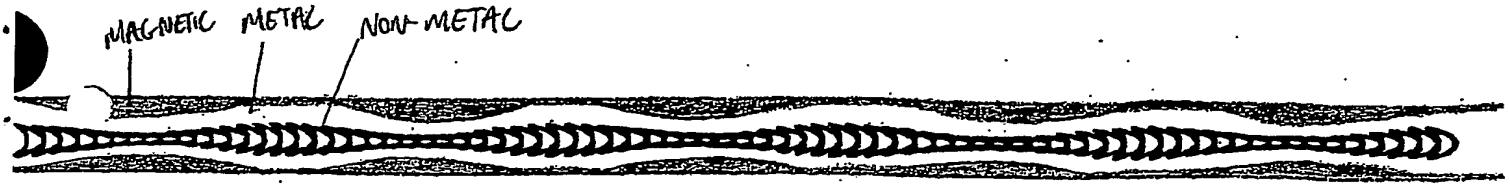

FIGURE 10

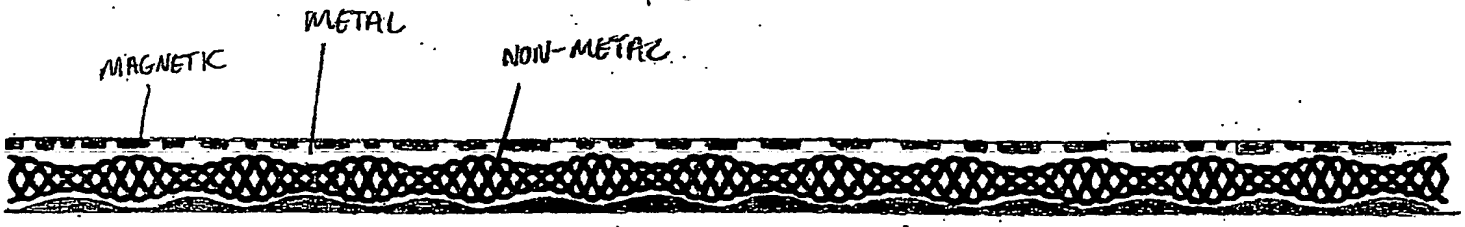

FIGURE 11

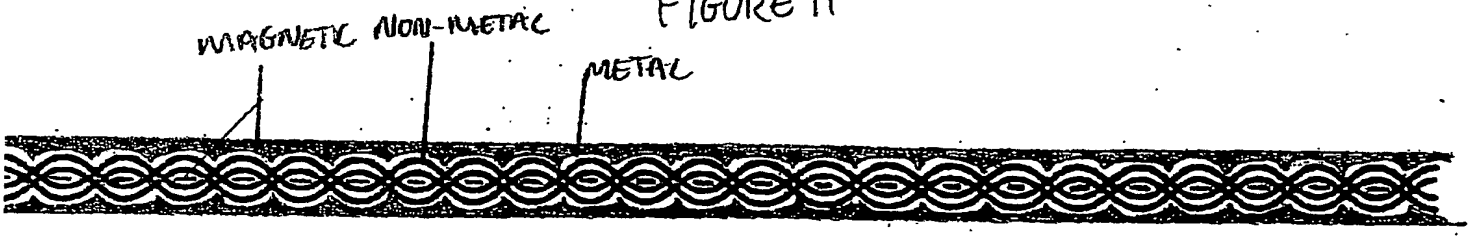

FIGURE 12

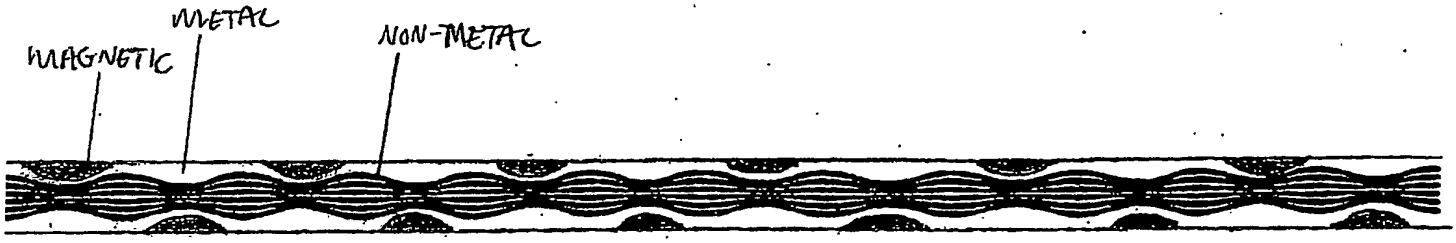

FIGURE 13

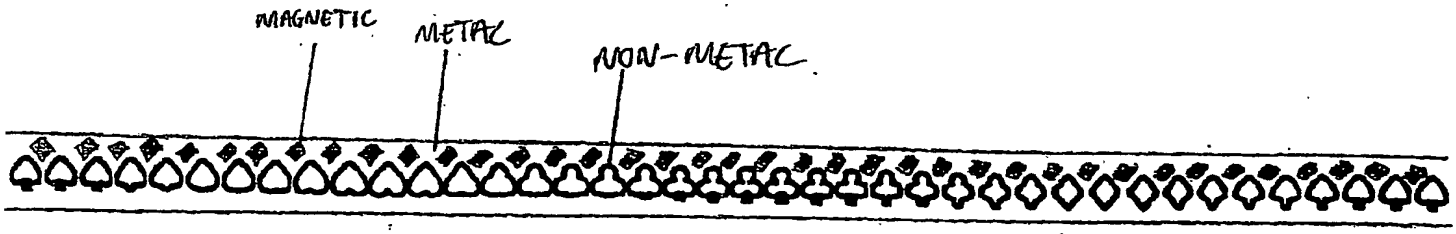

FIGURE 14

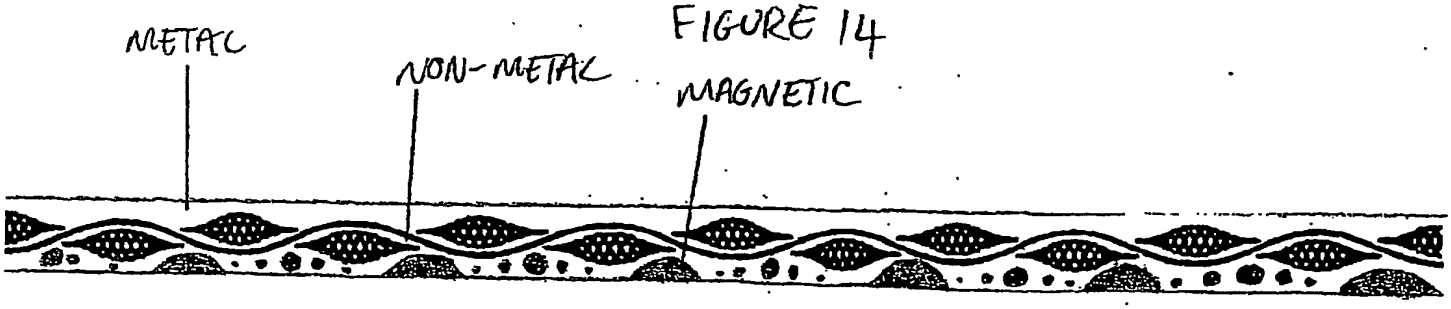

FIGURE 15

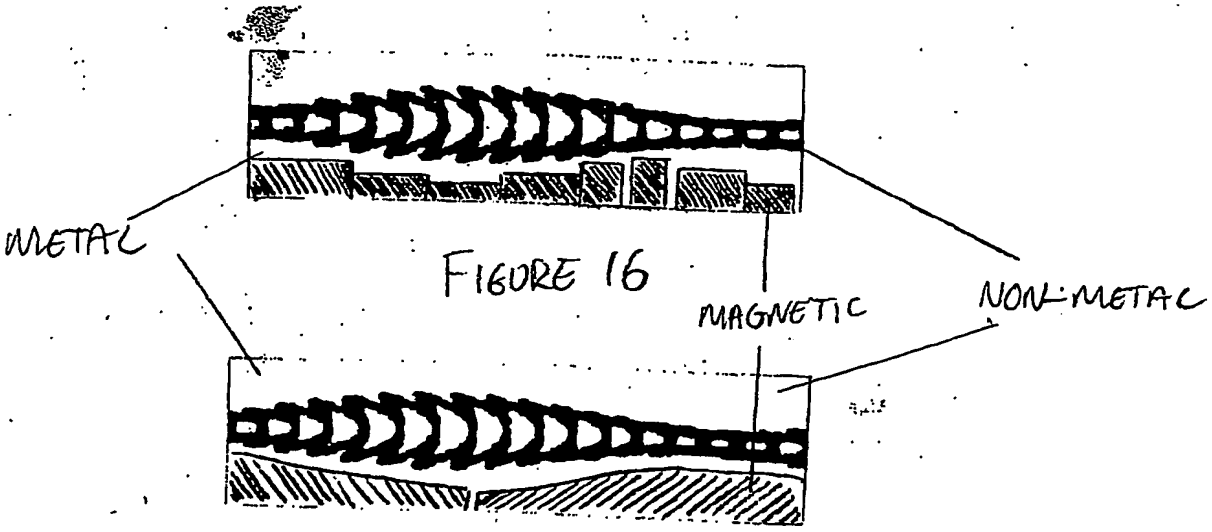

FIGURE 16

FIGURE 17

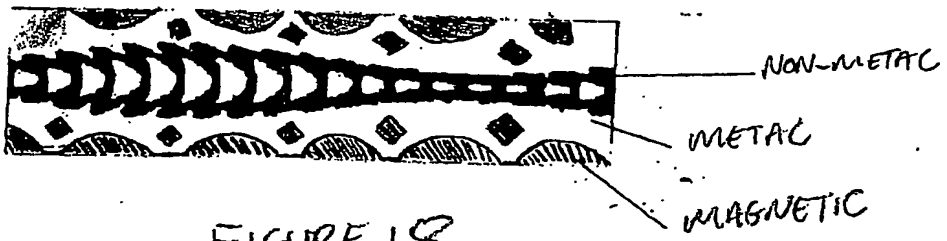

FIGURE 18

FIGURE 19

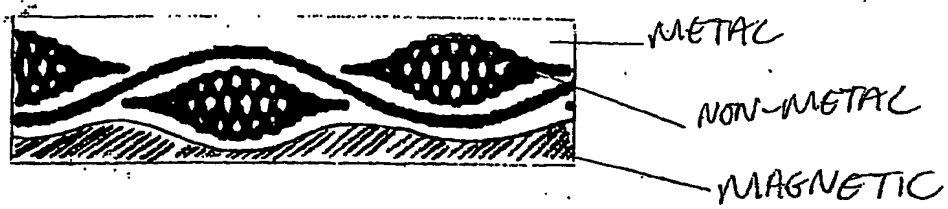

FIGURE 20

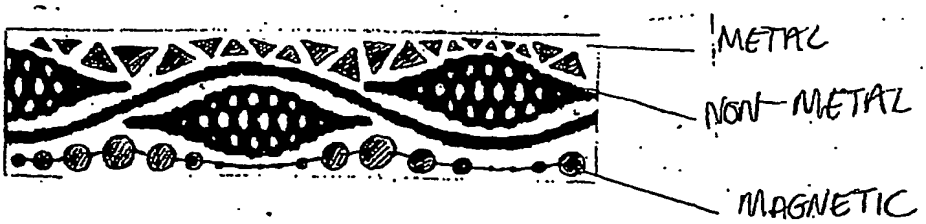

FIGURE 21

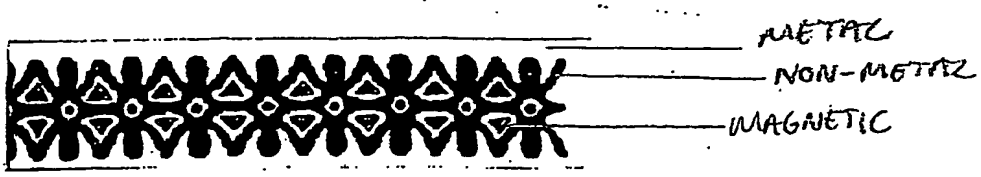

FIGURE 22

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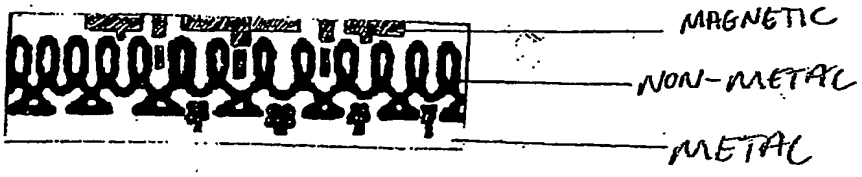

FIGURE 23

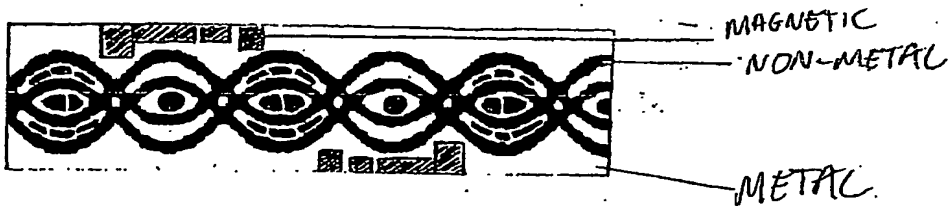

FIGURE 24

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